

National Transportation Safety Board

M/V Lady D Capsizing
DCA-04-MM-015

USCG Marine Safety Center Report, Feb 4, 2005

“Technical Support with the Investigation Surrounding the
Pontoon Vessel Lady D, O.N. MD8246BC”



16700/P010064
Serial: H1-0403040
4 Feb 2005

MEMORANDUM

From: W. R. REAMS
CG MSC-1

Reply to (202) 366-6481
Attn of: LT Connors/
LT Borlase

To: CG SECTOR Baltimore

Subj: TECHNICAL SUPPORT WITH THE INVESTIGATION SURROUNDING THE
PONTOON VESSEL LADY D, O.N. MD8246BC

1. We reviewed the stability of the LADY D as requested in your April 2, 2004 memorandum. Our response to your questions '2a' through '2c' is summarized in paragraphs (2) and (3). Enclosure (1) provides greater detail of our findings and describes the method of analysis.
2. The 25 persons allowed on the stability letter for the LADY D is the maximum personnel capacity the vessel could carry and still meet all applicable 46 CFR Subchapter S stability requirements. This personnel capacity was based on an assumed regulatory passenger weight of 140 pounds per person for a mixture of men, women, and children on a vessel on a protected route, which equated to a maximum assumed passenger weight of 3500 pounds. The actual passenger weight, as provided by the National Transportation Safety Board report, indicates the aggregate weight of personnel onboard was approximately 4200 pounds. With the assumed regulatory weight of passengers, the vessel met the minimum stability criteria in Subchapter S. However, with the actual aggregate weight of passengers on board, the vessel did not meet one of the applicable stability criteria. Specifically, it did not meet the minimum energy requirements in 46 CFR 170.173(e)(2)(iii) at the time of the casualty, achieving 70% of the required 10 foot-degrees of area under the righting arm curve between zero degrees and the angle of maximum righting arm. The difference between the assumed and actual passenger weight equates to a one-inch change in static freeboard. Given the dynamic environmental factors (explained below) that affected this casualty, we cannot determine whether this small gain in freeboard/buoyancy would have changed the response of the vessel to the adverse weather and sea conditions reported at the time of the casualty.
3. There are several dynamic factors that affect stability, not all of which are precisely known for the time of this casualty. They are at varying times cumulative or canceling, and their effects relative to the vessel's interdependent stability characteristics (i.e. maximum righting arm, area under the righting arm curve, range of stability, and heeling angle) result in an infinite and complex matrix of vessel reactions. Accordingly, we cannot reliably assess the stability required to survive the actual conditions due to the complexity of the calculations and the wide range of introduced error. The other factors involved are listed below in an estimated relative order beginning with the factors that would have the greatest impact on the vessel's stability.

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- a. Wind gusts reported by your office as high as 49 knots, which were stronger than the 43-knot steady wind assumed for vessels operating on protected waters.
 - b. A sea reported by your office as high as 4 feet, produced by the wind and fetch, which caused the vessel to heel more than expected on protected waters, and resulted in a significant drop in righting arm as one pontoon lifted out of the water.
 - c. Lift provided by the wind gust trapped under the pontoon deck that created an area of localized high-pressure, most likely due to a pontoon lifting out of the water.
 - d. A reported hard turn into the wind made by the master, which induced further heel to the vessel.
 - e. A sudden shift in the transverse center of gravity inside the vessel when passengers fell to one side, compounding the heel affects caused by the weather.
4. If you have any questions, or want to discuss any portion of the enclosed report, please contact the project officers, LT Connors or LT Borlase at the above numbers.

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Enclosure: (1) Marine Safety Center Method of Analysis and Findings on LADY D Capsizing

Copy: G-MOA

G-MS w/ copy of SECTOR Baltimore April 2, 2004 memorandum to MSC

MARINE SAFETY CENTER METHOD OF ANALYSIS AND FINDING ON LADY D CAPSIZING

Method of Analysis

1. In order to determine the lightship characteristics of the LADY D, the Marine Safety Center (MSC) evaluated the stability of three pontoon vessels: the LADY D, the PATRICIA P, and the MISTY HARBOR II. The vessels' lightship characteristics are summarized in Table 1.
2. The recovered LADY D was weighed using a certified truck scale in Dundalk, Maryland on August 11, 2004, in order to determine the vessel's lightship displacement and vertical center of gravity (VCG). Weight-moment calculations were performed to include the weight of the superstructure and other gear missing from the vessel after the capsizing. The lightship VCG of the vessel was estimated based on photographs and drawings depicting the construction of the hull, superstructure, and installed seating.
3. In order to validate the calculated lightship values for the LADY D, the MSC inclined two similar pontoon vessels built by the same manufacturer. The PATRICIA P was inclined in Dundalk, Maryland on April 14, 2004, and the MISTY HARBOR II was inclined in Willow Street, Pennsylvania, on October 13, 2004. As shown in Table 1, both the PATRICIA P and MISTY HARBOR II had slightly higher lightship displacements and lightship VCGs than the LADY D.

Table 1 – Characteristics of Vessels

Name	LADY D	MISTY HARBOR II	PATRICIA P (Ex- FELLE PT. PRINCESS)
Official No.	CG050322	PA5318BR	CG004970
Pontoon Length	36 feet		
Pontoons	2 @ 24 inches in diameter		
Distance Between Pontoon Centers	73.5 inches		68 inches
Build Date	March 1996	May 1996	June 1986
Builder	Susquehanna Santee Boat Works		
Lightship Weight	4,155 lbs. ¹	4,649 lbs. ²	4,574 lbs. ³
Lightship VCG (above deck)	0.88 feet ¹	1.61 feet ²	1.41 feet ³

Notes:

1. Determined by weighing in Dundalk, Maryland on August 11, 2004.
2. Determined by inclining experiment in Willow Street, Pennsylvania on October 13, 2004.
3. Determined by inclining experiment in Dundalk, Maryland on April 14, 2004.

4. The MSC performed a pontoon simplified stability test in accordance with 46 CFR 178.340 on both the PATRICIA P and MISTY HARBOR II. The maximum number of passengers allowed based on the results of the pontoon simplified stability proof test for the PATRICIA P and MISTY HARBOR II are included as Table 2.

MARINE SAFETY CENTER METHOD OF ANALYSIS AND FINDING ON LADY D CAPSIZING

5. MSC used Creative System's "General Hydrostatics" (GHS) stability software to evaluate the stability characteristics of all three vessels. Each of the three pontoon vessels was loaded with fuel and the maximum number of passengers calculated to meet the applicable intact stability requirements:

- a. 46 CFR 170.170, Minimum GM with Wind Heeling Moment, protected waters
- b. 46 CFR 170.173(e)(2), Criterion for vessels of unusual proportion and form
- c. 46 CFR 171.050, Minimum GM with Passenger Heeling Moment

The maximum number of passengers allowed based on the results of the intact stability calculations for the LADY D, PATRICIA P, and MISTY HARBOR II are included as Table 2.

Table 2 – Maximum Persons Permitted

Name	LADY D	MISTY HARBOR II		PATRICIA P	
Type of Test	Calculation	Simplified	Calculation	Simplified	Calculation
Date of Test	2004	2004	2004	2004	2004
Max Persons (@140#/ea)	25	15	21	17	20
Max Persons (@168#/ea)	21	12	17	14	16

Findings

6. Based on MSC's calculated lightship values and the estimated loading condition of the vessel at the time of the casualty, the LADY D met the wind heel criteria for protected waters in 46 CFR 170.170, and the passenger heel criteria in 46 CFR 171.050. The LADY D met all minimum righting arm requirements in 46 CFR 170.173(e)(2) with exception of the "area under the curve" requirement. The LADY D most likely had no more than 7.02 foot-degrees of area under the righting arm curve between zero and the angle of maximum righting arm, which is less than the 10 foot-degrees required.

7. Based on MSC's calculated lightship values, the maximum number of persons (passengers and crew) that the LADY D could carry and still meet all the applicable stability criteria in 46 CFR Subchapter T was 25 persons, at an average weight of 140 pounds per person.

8. Although the maximum number of persons the LADY D could carry is the same as the number of persons onboard at the time of the casualty, the weight of passengers is not equal. The pontoon simplified stability proof test and stability calculations in accordance with 46 CFR 178.330(a)(4)(ii) assume 140 pounds per person for a mixture of men, women, and children when operating on protected waters, corresponding to 3500 pounds total passenger weight. However, the average passenger weight at the time of the casualty was 168 pounds and the total passenger weight was 4200 pounds, which is 20% greater than assumed in the simplified test.

MARINE SAFETY CENTER METHOD OF ANALYSIS AND FINDING ON LADY D CAPSIZING

9. The intact stability characteristics of the vessel are not independent of one another and the impact on the vessel's stability from dynamic environmental and operational factors is not easily determined. As such, it is not currently possible to quantify the stability necessary to survive the weather conditions at the time of the casualty. However, it is unlikely that meeting the minimum stability requirements for operating on protected waters would have ensured the LADY D could survive the weather encountered at the time of the capsizing. While reducing the passenger load by 700 pounds would cause the vessel to meet the stability requirements in 46 CFR Subchapter T, the vessel's draft would only decrease 1 inch. Based on the dynamic nature of the capsize, it is not clear that such a small change in freeboard and draft would increase the vessel's chance of survival.